REMARKS

This is in response to the Office Action dated April 25, 2003. Claims 16-17 have been canceled. New claims 21-30 have been added. Thus, claims 1-15 and 18-30 are now pending.

Applicant notes with appreciation the courtesy extended by the Examiner during the interview held at the USPTO on October 9, 2003. The substance of the interview is set forth below.

Section 112 Rejection

Claims 2-3 stand rejected under 35 U.S.C. Section 112, second paragraph. In particular, the Office Action objects to the phrase "rotational symmetry" and contends that it is indefinite. This Section 112 rejection is respectfully traversed for at least the following reasons.

The phrase "rotational symmetry" is a well-known phrase used to describe shapes. Exhibits 1-3 attached hereto illustrate typical uses of the phrase "rotational symmetry", thereby evidencing the clear ordinary meaning of the phrase.

- Exhibit 1: Steven Dutch, Natural and Applied Sciences, University of Wisconsin – Green Bay. *Symmetry around a Point in the Plane*;
- Exhibit 2: *What is Rotational Symmetry*? URL: http://www.adrianbruce.com/Symmetry/120.htm.;

- Exhibit 3: Shoemaker, David, Carl Garland and Joseph Nibler, *Experiments in Physical Chemistry*. 5th Edition, McGraw-Hill, Inc. (pgs. 555-558).

As stated in Exhibit 1, the phrase "rotational symmetry" is used to describe objects having parts that "are related by rotation . . . . As a general rule, you can rotate such an object through a certain angle and it will still have the same appearance." For example, in figure b of Exhibit 1 the rotationally symmetrical shape "looks the same three times during a 360 degree rotation and is said to have three-fold [rotational] symmetry."

Stated yet another way, Exhibit 2 recites that "[a]n image has rotational symmetry if there is a centre point around which the object is turned a certain number of degrees and the object still looks the same, [i.e.,] it matches itself a number of times while it is being rotated."

Exhibits 1-3 clearly show that the phrase "rotational symmetry" is clear and definite as to its meaning. Such a well known and defined phrase cannot be indefinite. Thus, the Section 112 rejection should be withdrawn.

<u>Claim 1</u>

Claim 1 stands rejected under 35 U.S.C. Section 102(e) as being allegedly anticipated by Yoshida. This Section 102(e) rejection is respectfully traversed for at least the following reasons.

Claim 1 requires that "when a voltage is applied between the first electrode and the second electrode, a plurality of liquid crystal domains are formed in the plurality of

openings and the solid portion by inclined electric fields generated at respective edge portions of the plurality of openings of the first electrode, for producing a display by changing orientation states of the plurality of liquid crystal domains in accordance with the applied voltage, and wherein each of said liquid crystal domains includes: (a) first liquid crystal molecules oriented substantially parallel to a normal of the first substrate thereby defining an axis, and (b) second liquid crystal molecules existing around all lateral sides of said axis and radially inclined relative to the axis."

For example and without limitation, Fig. 2B of the instant application illustrates that when a voltage is applied between the first electrode 14 and the second electrode 22, a plurality of liquid crystal domains are formed in the plurality of openings 14a and the solid portion 14b by inclined electric fields (see equipotential lines EQ) generated at respective edge portions EG of the plurality of openings of the first electrode. As shown in Figs. 2B, 4C, 5, 15B, and 19 for example, and without limitation, each such domain formed by these inclined electric fields EQ at the edge portions EG of the openings includes: (a) first liquid crystal molecules oriented substantially parallel to a normal of the first substrate thereby defining an axis, and (b) second liquid crystal molecules existing around all lateral sides of said axis and radially inclined relative to the axis. For example, Fig. 2B illustrates first liquid crystal molecules oriented along axes SA so as to be parallel to a normal of the first substrate. The second molecules are radially inclined relative to the first molecules around all lateral sides thereof as shown in Figs. 2B, 4C, 5,

15B, and 19 for example. This allows viewing angle dependence of display quality to be reduced, thereby resulting in improved display characteristics.

The cited art fails to disclose or suggest the aforesaid underlined and quoted aspect of claim 1.

Yoshida, in particular, fails to disclose or suggest any sort of liquid crystal domain including "(a) first liquid crystal molecules oriented substantially parallel to a normal of the first substrate thereby defining an axis, and (b) second liquid crystal molecules existing around all lateral sides of said axis and radially inclined relative to the axis" as recited in claim 1. The difference between Yoshida and an example embodiment of this invention is shown in Exhibit 4 attached hereto.

In particular, the left-hand drawing of Exhibit 4 shows that stripe-shaped electrode 20 in Yoshida, in combination with parallel stripe-shaped common electrodes 18, causes the liquid crystal molecules on either side of stripe-shaped electrode 20 to be oriented in the *same* direction slanting away from the electrode 20. In this regard, Exhibit 4 is a top view of the effect caused by Fig. 4 of Yoshida. In contrast, the right-hand drawing of Exhibit 4 is Fig. 4C of the instant application – an example of domains according to this invention. It can be seen from the right-hand side of Exhibit 4 that the liquid crystal molecules in each domain are radially inclined relative to the domain's central axis *around all lateral sides* of the axis. The difference between Yoshida and certain embodiments of this invention is clear.

In particular, Yoshida clearly fails to disclose or suggest any sort of liquid crystal domain which includes "(a) first liquid crystal molecules oriented substantially parallel to a normal of the first substrate thereby defining an axis, and (b) second liquid crystal molecules existing around ***all lateral sides*** of said axis and radially inclined relative to the axis" as recited in claim 1. Yoshida is entirely unrelated to the invention of claim 1 in this regard. Claim 1 cannot possibly be anticipated or otherwise unpatentable in view of Yoshida.

Claim 4

Claim 4 requires that "each of the at least some of the plurality of openings is in a substantially circular shape." For example, Fig. 9 of the instant application illustrates circular openings 14a in the first electrode 14.

Yoshida fails to disclose or suggest this aspect of claim 4. Moreover, one of ordinary skill in the art would recognize that Yoshida's electrodes 18, 20 must be parallel for the display to function properly; thus, one of ordinary skill in the art would never have modified Yoshida to provide for substantially circular openings as called for in claim 4.

Furthermore, Uemura also fails to disclose or suggest substantially circular openings in a first electrode as called for in claim 4. Uemura in Fig. 1 merely discloses polymer walls, not openings in electrode(s). Thus, even the alleged combination of Yoshida and Uemura would fail to meet the invention of claim 4.

Claim 5

Claim 5 requires that "each region of the solid portion surrounded with the at least some of the plurality of openings is in a substantially circular shape." For example, Fig. 1A of the instant application illustrates solid portions 14b that are substantially circular in shape. Again, the cited art fails to disclose or suggest this aspect of claim 5, either alone or in combination.

Yoshida requires parallel electrodes, and thus cannot possibly disclose or suggest electrode solid portions that are substantially circular in shape as called for in claim 5. Figs. 28-30 of Yoshida are not top views, but are side cross sectional views. The parallel stripe-shaped electrodes 72, 76 of Yoshida have no substantially circular shaped portions as viewed from above.

Moreover, Uemura in Fig. 6 also fails to disclose or suggest this aspect of claim 5. Fig. 6 is a graph, not a view of an electrode.

Since both Yoshida and Uemura fail to disclose or suggest the claimed invention of claim 5, it can be seen that even if the references were combined (which applicant believes would be incorrect in any event), the invention of claim 5 still would not be met.

Claim 6

Claim 6 requires that "each region of the solid portion surrounded with the at least some of the plurality of openings is in a substantially rectangular shape with substantially arc-shaped corners." E.g., see Fig. 7B and 8B of the instant application.

Again, both Yoshida and Uemura fail to disclose or suggest this aspect of claim 6. Thus, even if the references were combined (which applicant believes would be incorrect in any event), the invention of claim 6 still would not be met.

Claim 7

Claim 7 requires that "in each of the plurality of picture element regions, a total area of the plurality of openings of the first electrode is smaller than an area of the solid portion of the first electrode." The cited art fails to disclose or suggest this aspect of claim 7, either alone or in combination.

Claim 8

Claim 8 calls for "a protrusion within each of the plurality of openings, wherein a cross-sectional shape of the protrusion taken along a plane direction of the substrate is the same as a shape of the corresponding opening, and a side face of the protrusion has an orientation-regulating force for orienting liquid crystal molecules of the liquid crystal layer in the same direction as an orientation-regulating direction obtained by the inclined electric field."

The cited art discloses nothing akin to this aspect of claim 8. Uemura's polymer wall cited by the Office Action is not formed in any opening, and thus cannot possibly have a shape that is substantially the same as the opening as called for by claim 8. Again, the art is entirely unrelated to the invention of claim 8.

Claim 9

Claim 9 requires that a "plurality of liquid crystal domains are in a ***spirally*** radially-inclined orientation state." Again, the cited art fails to disclose or suggest this aspect of claim 9, either alone or in combination. Uemura uses a horizontally aligned type LC material, where claim 9 (via claim 1) uses an LC material that is of the substantially vertically aligned type for forming a spirally radially-inclined orientation state. The two are entirely unrelated to one another.

Claim 18

Claim 18 requires that "the first electrode includes a plurality of openings and a solid portion, at least some of the plurality of openings have substantially the same shape and the same size, and form at least one unit lattice arranged so as to have rotational symmetry, and wherein each region of the solid portion surrounded with at least some of the plurality of openings is in a substantially circular shape." For example, Fig. 1A of the instant application illustrates solid portions 14b that are substantially circular in shape. Again, the cited art fails to disclose or suggest this aspect of claim 18, either alone or in combination.

Yoshida requires parallel *stripe-shaped* electrodes, and thus cannot possibly disclose or suggest electrode solid portions substantially circular in shape as called for in claim 18. Figs. 28-30 of Yoshida are not top views, but are side cross sectional views. The parallel stripe-shaped electrodes 72, 76 of Yoshida have no substantially circular shaped solid portions.

Moreover, Uemura in Fig. 6 also fails to disclose or suggest this aspect of claim 18. Fig. 6 is a graph, not a view of an electrode.

Since both Yoshida and Uemura fail to disclose or suggest the claimed invention of claim 18, it can be seen that even if the references were combined (which applicant believes would be incorrect in any event), the invention of claim 18 still would not be met.

Claim 19

Claim 19 requires that for the first electrode, "each region of the solid portion surrounded with at least some of the plurality of openings is in a substantially rectangular shape with substantially arc-shaped corners." E.g., see Fig. 7B and 8B of the instant application.

Again, both Yoshida and Uemura fail to disclose or suggest this aspect of claim 19. Thus, even if the references were combined (which applicant believes would be incorrect in any event), the invention of claim 19 still would not be met.

Claim 20

Claim 20 requires that the "solid portion includes a plurality of island portions arranged in the form of an m x n matrix and a plurality of branch portions for electrically connecting adjacent pairs of the plurality of island portions, and the number of the plurality of branch portions is smaller than (2mn – m – n)." Again, the cited art fails to disclose or suggest this aspect of claim 20.

<u>Claim 24</u>

Claim 24 requires that "when a voltage is applied between the first electrode and the second electrode, a liquid crystal domain is formed in each of the plurality of openings and each of the plurality of unit solid portions by inclined electric fields generated at respective edge portions of the plurality of openings of the first electrode, and wherein at least one of said liquid crystal domains includes: (a) first liquid crystal molecules oriented substantially parallel to a normal of the first substrate thereby defining an axis that is substantially normal to the first substrate, and (b) second liquid crystal molecules existing *around all lateral sides of said axis and radially inclined relative to said axis*." Again, the cited art fails to disclose or suggest this aspect of claim 24.

<u>Claim 25</u>

Claim 25 requires that "when a voltage is applied between the first electrode and the second electrode, a liquid crystal domain is formed in each of the plurality of unit solid portions by inclined electric fields generated at respective edge portions of the nonsolid portion of the first electrode, wherein the liquid crystal domain includes first liquid crystal molecules oriented substantially parallel to a normal of the first substrate thereby defining an axis that is substantially normal to the first substrate, and *second liquid crystal molecules existing around <u>all lateral sides</u> of said axis and radially inclined relative to said axis*." Again, the cited art fails to disclose or suggest this aspect of claim 25.

Claim 27

Claim 27 requires that for a domain "liquid crystal molecules which are inclined and symmetrically oriented around all lateral sides of a vertical domain axis (SA) located in the corresponding opening, and wherein at least one liquid crystal molecule along the vertical domain axis (SA) at each openings is oriented in a vertical state when the substantial voltage is applied and wherein at least some liquid crystal molecules on opposite sides of the vertical domain axis (SA) for each opening are inclined in opposite directions." Again, the cited art fails to disclose or suggest this aspect of claim 27.

Miscellaneous

Following the interview, the Examiner called the undersigned and requested a brief explanation as to U.S. Patent Nos. 6,342,938 and 6,078,376. Responsive thereto, it is noted that the '938 Patent relates to an MVA-type LCD which discloses LC molecules only being aligned in two or four directions. Thus, in contrast to claim 1 of the instant application, the '938 Patent fails to disclose or suggest both the (a) and (b) types of molecule orientations recited in that claim. Meanwhile, the '376 Patent fails to disclose or suggest forming a plurality of domains per a first electrode (in contrast with claim 1 of the instant application) – the '376 Patent is entirely unrelated to the invention of claim 1 in this regard.

Conclusion

For at least the foregoing reasons, it is respectfully requested that all rejections be withdrawn. All claims are in condition for allowance. If any minor matter remains to be resolved, the Examiner is invited to telephone the undersigned with regard to the same.

Respectfully submitted,

NIXON & VANDERHYE P.C.

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Rotational Symmetry

Parts of an object are related by rotation. As a general rule, you can rotate such an object through a certain angle and it will still have the same appearance.

The figures below have rotational symmetry:

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(a.)              (b.)   /       (c.)|______     (d.)
=====                  /\            |     |          /___
66///*///99           /  \           |     |        \/   \
      =====        __/____\       ___|_____|        _\_ /\
                           \               |           /
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- In Figure a., the parts are related by a rotation around the center by 180 degrees. The figure looks the same twice in a 360-degree rotation. We say it has two-fold symmetry. The letters Z S and N also have two-fold symmetry.
- Figure b. looks the same three times during a 360-degree rotation and is said to have three-fold symmetry.
- Figure c. has four-fold symmetry and:
- d. has six-fold symmetry.
- An object is said to have n-fold symmetry if it looks the same after being rotated 360/n degrees.
- The point around which we rotate the object is called a **symmetry axis.**

Handedness (Chirality, Enantiomorphism)

Objects with rotational symmetry but no reflection symmetry exist in two forms that we might call "left-handed" and "right-handed". Objects with reflection symmetry are their own mirror image. Rotation symmetry without reflection is often used in graphic design to portray the idea of speed, power, or dynamic action.

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    /        \       |_____   _____|
   /\       /\       |    |   |    |          /\   |¯¯¯¯|
  /  \     /  \      |    |   |    |         /  \  |    |
_/____\   /____\__ __|____|   |____|__      /____\ |____|
       \ /            |       |
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Rotation Symmetry without Reflection       Rotation and
                                           Reflection
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In chemistry, the fact that some molecules have left- and right- handed versions is called **chirality** from the Greek word for hand. The same root appears in the word "chiropractor." In crystallography, shapes that lack mirror symmetry are called **enantiomorphic**.

Symmetry and the Real World

Note that, because we are using keyboard characters, the figures are not perfectly symmetrical. Real objects never are. Even in a crystal, there are impurity atoms and defects that spoil the perfect

Document (c)

rotational symmetry, turning symmetry, rotational symmetry for kids

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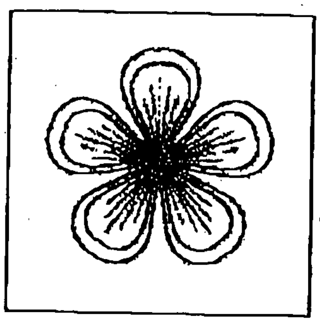
Rotational Symmetry

An image has **Rotational Symmetry** if there is a centre point around which the object is turned a certain number of degrees and the object still looks the same, ie it matches itself a number of times while it is being rotated.

Since this triangle will match itself **3 times** as it is rotated it is said to have rotational symmetry of **Order 3**.



This flower has rotational symmetry of **Order 5** since it matches itself **5 times**.

Since all the toppings are placed so evenly, this pizza has rotational symmetry of **Order 6**.

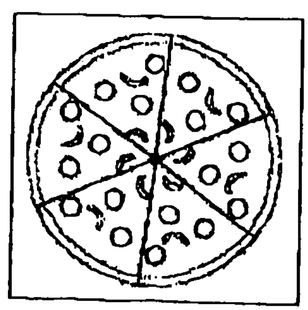


Exhibit 2

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Often the picture cards in a playing deck have rotational symmetry.

NB According to the New South Wales Mathematics Syllabus,
*'... If an object only matches itself once, it is **NOT** considered to have rotational symmetry.'*

Document (A) 1/4

tion of the crystal axes and the direct lattice, but also determines the orientation of the r.l. If the crystal is caused to rotate in direct space, the r.l. rotates correspondingly about its origin O in reciprocal space. For a beam of strictly parallel and absolutely monochromatic x-rays (so that s_0/λ is exactly defined) and a given arbitrary orientation of the crystal, the probability that the Ewald sphere passes through any r.l.p. (other than the origin) is infinitesimal. Therefore, in *diffraction cameras* the crystal is caused to undergo some kind of rotatory, oscillatory, or precessional motion. During the corresponding motion of the r.l., some of the r.l.p.'s pass through the stationary Ewald sphere. As each r.l.p. passes through the sphere, the geometrical conditions for diffraction are satisfied for an instant and a "flash" of reflected x-rays impinges upon the photographic film and exposes some grains in the emulsion. This process is repeated at this point on the film hundreds or thousands of times because of repetition of the mechanical cycle of the instrument. When the film is developed there appears a diffraction "spot" with a size and shape determined by the size and shape of the crystal specimen and by the angle of divergence ($\lesssim 1°$) of the incident x-ray beam. The intensity (blackness) of this spot depends on constructive or destructive interference of the x-ray wavelets scattered by the individual atoms in the unit cell. In the Buerger precession camera the film is moved in synchronization with the crystal motion so that the position of the spot on the developed film reveals the position (Miller indices) of the corresponding r.l.p. in reciprocal space.

The point group and crystal class. The theory of symmetry and the development of the point groups and space groups is a complex subject.[4] We will here dispense with formal group theory; indeed we will dispense with all kinds of symmetry that are not encountered in the one crystallographic system to which the present experiment is limited: the orthorhombic system.

We must first introduce the *point group*, a collection of symmetry elements that specify the symmetry of a finite object.† The only point-symmetry elements that occur in the orthorhombic system are:

- the identity element (trivial, possessed by every object),
- the two-fold rotation axis, designated by the symbol 2, representing invariance to a 180° rotation,
- the mirror plane, designated by the symbol m, representing invariance to reflection in a plane, and
- the center of inversion (often called *center of symmetry*), designated by the symbol i, representing invariance to inversion through a point.

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†The point group can also be applied to an infinite object, such as a crystal lattice, a crystal structure, a reciprocal lattice, or an "intensity-weighted" reciprocal lattice.

Exhibit 3

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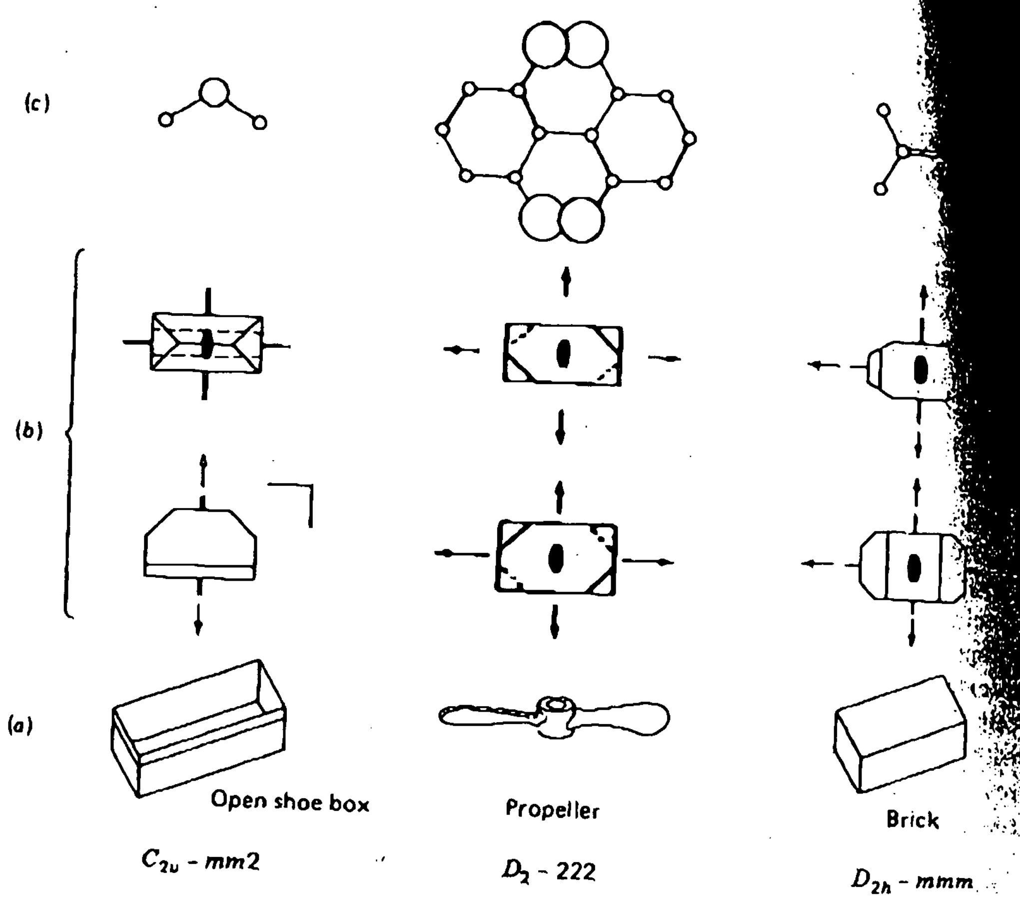

FIGURE 3

The three orthorhombic point groups with examples: (*a*) familiar objects, (*b*) hypothetical crystals showing the point group in their morphology, and (*c*) chemical molecules. In part (*b*), the conventional graphical symbols for the elements are superimposed: a right-angled line for a mirror plane parallel to the paper and a single straight line trace for one perpendicular to it; an arrow and a "lens" for twofold rotation axes, and a small circle for a center of inversion ("center of symmetry").

There are 32 crystallographic point groups, and the orthorhombic system contains three (see Fig. 3):

C_{2v} or $mm2$ = two mirror planes crossing at right angles, generating a two-fold axis at their line of intersection. Examples of objects conforming to this point group: an open shoe box; the molecules H_2O, SO_2, H_2CO (formaldehyde).

D_2 or 222 = three two-fold axes intersecting at right angles (actually, any two of the three suffice to generate the third). Examples: a two-bladed propeller without shaft; a molecule of 2,6,2′,6′-tetraiodobiphenyl (twisted out of the planar configuration by steric repulsion of the iodine atoms).

D_{2h} or mmm = three mirror planes intersecting at right angles, generating

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three two-fold axes at their lines of intersection *and* (very importantly) a center of inversion. Examples: a brick; the molecules C_2H_4 (ethylene), and B_2H_6 (bridge structure of diborane). This point group contains all of the elements of $C_{2v} - mm2$ and all of the elements of $D_2 - 222$; those two point groups are said to be *subgroups* of $D_{2h} - mmm$.

In each case, two symbols for each point group have been given. The first is the Schoenflies symbol, often used in spectroscopy. The second is the Hermann–Mauguin symbol, much more commonly used in crystallography. The three positions in the Hermann–Mauguin symbol for orthorhombic point groups correspond to the three assigned crystal axes **a**, **b**, **c** and each is occupied by a letter or numeral designating the symmetry element operating with respect to the corresponding direction. *The direction in the case of the mirror plane is that of its normal.* Clearly, with different axial assignments, a crystal may have point group symmetry $2mm$ or $m2m$; these are equivalent to $mm2$ and all three correspond to the Schoenflies symbol C_{2v}.

Corresponding to each point group is a *crystal class*; all crystals having the same point-group symmetry are said to belong to the same crystal class. Thus there are three orthorhombic crystal classes, which are given the same identifying symbols as the corresponding point groups. The crystal class or point group of a given crystal is ultimately defined by its atomic structure, but the macroscopic properties of the crystal—its optical, elastic, piezoelectric, and pyroelectric properties, and also ideally its external morphology—must conform to the symmetry of the point group. However, the information required for the complete specification of the crystal point group is often not available from macroscopic properties alone.

One might then hope that all of the required information can be obtained from x-ray diffraction experiments. Unfortunately, with ordinary photographic methods such as those employed in this experiment, it is generally not possible to detect any significant difference in Bragg reflection intensity between reflections hkl and $\bar{h}\bar{k}\bar{l}$. That is, the x-ray experiment by itself seems to confer upon the crystal an apparent center of inversion, and thus is incapable of showing whether or not the crystal really possesses a center of inversion. (This limitation is known as Friedel's law.) The intensity-weighted r.l., i.e., the r.l. weighted with the Bragg reflection intensities, therefore possesses for all orthorhombic crystals, the centrosymmetric $D_{2h} - mmm$ point-group symmetry. Accordingly, all orthorhombic crystals are said to have $D_{2h} - mmm$ "Laue symmetry." Without further information it is impossible to determine which of the three orthorhombic point groups is correct for a given crystal. As we shall see, the presence of *screw axes*, *glide planes*, or both can be inferred from certain systematic extinctions, and in some cases certain combinations of these can uniquely define the space group and point group. In many other cases, either physical methods must be used, or ambiguity will remain until the entire crystal structure has been successfully determined, possibly after trials with alternative space groups.

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For crystals that do not conduct electricity, the final ambiguity may often be resolved by study of the piezoelectric or pyroelectric properties of the crystal. Crystals with $D_{2h} - mmm$ symmetry cannot show either the piezoelectric effect or the pyroelectric effect; those with $D_2 - 222$ can show the former but not the latter; those with $C_{2v} - mm2$ can show both. Details are given by Wooster and Breton.[5] Another method, novel and sensitive, applicable to transparent crystals (even if they have some electrical conductivity), involves determination of the capability of the crystal to generate second harmonics in a laser beam.[6]

The space group. The crystal structure, idealized, is perfectly "lattice periodic" and infinite in extent in all three dimensions. A complete statement of the symmetry of the structure must take this into account. Such a statement is the specification of the space group.

An excellent introduction to space groups is given by Buerger.[7] A complete tabulation of all 230 possible space groups in three dimensions, with extensive and detailed tables and diagrams, is given in vol. A, Symmetry Groups, of *International Tables for Crystallography*,[8] hereinafter abbreviated as *I.T.*

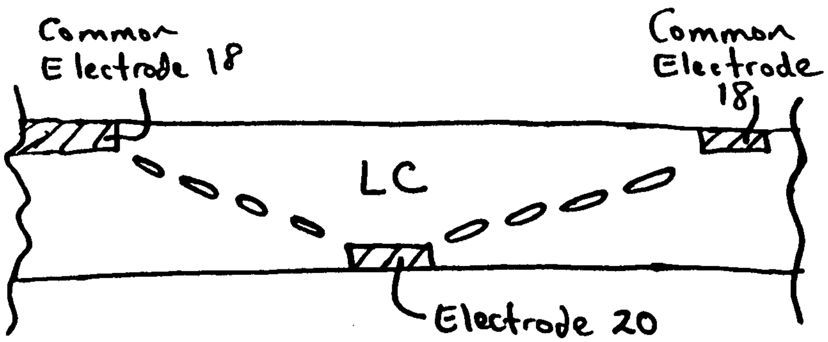
The same symmetry elements that we encountered in the point groups may exist in the space group, but they are repeated by the lattice and are present in an infinite number of positions. In addition, certain elements occur that do not occur in point groups because they cannot be possessed by a finite object. These include the elements of translation, corresponding to the periodic crystal lattice. In addition to these there are, in many space groups, elements that combine translations with rotations or reflections: in the orthorhombic system these are the two-fold screw axes and various glide planes. The two-fold screw axis corresponds to a 180° rotation *accompanied by a simultaneous translational shift of one-half a lattice translation* (lattice-point separation vector) in the direction of the rotation axis; it is designated by the symbol 2_1. The glide plane similarly corresponds to a reflection accompanied by a translational shift of one-half a lattice translation in a direction parallel to the plane of reflection; it is designated a, b, c, or n according to whether the translational shift is by $\mathbf{a}/2$, $\mathbf{b}/2$, $\mathbf{c}/2$, or a diagonal direction, e.g., $(\mathbf{b} + \mathbf{c})/2$ for an n glide plane normal to $\mathbf{a}$.† The two-fold screw axis and the glide plane are illustrated in Fig. 4.

As in the cubic system (Exp. 45), the lattice in the orthorhombic system may be primitive P, body-centered I, or face-centered F. In addition, a lattice in the orthorhombic system may be end-centered—i.e., the unit cell is centered on only one pair of opposing faces instead of all three. The lattice is then designated by a capital letter corresponding to the crystal axis *not* contained in the centered face: C if the centering point is at $(\frac{1}{2}, \frac{1}{2}, 0)$; A if it is at $(0, \frac{1}{2}, \frac{1}{2})$; B i

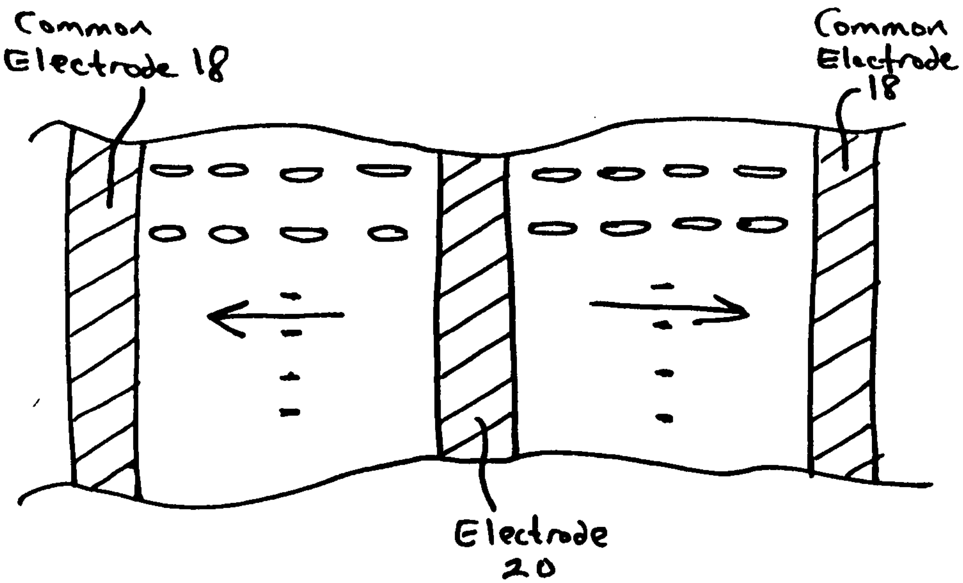
† An additional glide plane d, with a translational shift of one-quarter cell face diagonal, occurs in only two of the 59 orthorhombic space gr ups and will not be discussed here.

Yoshida

Cross Section



Top View



Example of Instant Invention

Top View (Fig. 4C)

FIG. 4C

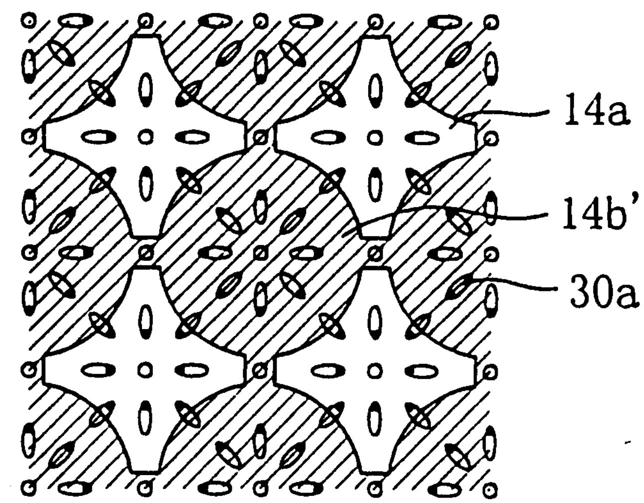


Exhibit 4

Nixon & Vanderhye P.C.

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*UNDERSIGNED LICENSED ONLY IN MD AND PRACTICE LIMITED TO FEDERAL LAW

October 24, 2003

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Subject: U.S. Patent Application of KUBO et al.
Serial No. 09/923,344
Title: LIQUID CRYSTAL DISPLAY DEVICE
Your Ref.: A3015SH-US1
Our Ref.: 4034-27

Dear Mr. Yamashita:

In response to your letter of instructions dated October 23, 2003, please find enclosed herewith an Amendment as filed with the USPTO on October 24, 2003, along with a three month Extension of Time Fee in response to the Office Action dated April 25, 2003. Moreover, please note that we have canceled claims 16-17 and added new claims 21-30.

Please let us know if you should have any questions with regard to the above. Our debit note for services and disbursements to date is enclosed with the confirmation copy of this letter.

Very truly yours,

NIXON & VANDERHYE P.C.

By: ______________________
Joseph A. Rhoa

JAR:caj
Enclosures

786635

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Patent Application of — Atty Dkt. 4034-27 C# M#

KUBO et a. — Group Art Unit: 2814

Serial No. 09/923,344 — Examiner: Rao, Shrinivas

Filed: 8/8/01 — Date: October 24, 2003

Title: LIQUID CRYSTAL DISPLAY DEVICE

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

RESPONSE/AMENDMENT/LETTER

This is a response/amendment/letter in the above-identified application and includes an attachment which is hereby incorporated by reference and the signature below serves as the signature to the attachment in the absence of any other signature thereon.

☐ **C rrespondence Address Indication Form Attached.**

Fees are attached as calculated below:

Total effective claims after amendment **28** minus highest number previously paid for **20** (at least 20) = 8 x $ 18.00	$ 144.00
Independent claims after amendment **7** minus highest number previously paid for **3** (at least 3) = 4 x $ 86.00	$ 344.00
If proper multiple dependent claims now added for first time, add $290.00 (ignore improper)	$ 0.00
Petition is hereby made to extend the current due date so as to cover the filing date of this paper and attachment(s) ($110.00/1 month; $420.00/2 months; $950.00/3 months)	$ 950.00
Terminal disclaimer enclosed, add $ 110.00	$ 0.00
☐ First/second submission after Final Rejection pursuant to 37 CFR 1.129(a) ($770.00) ☐ Please enter the previously unentered , filed ☐ Submission attached	$ 0.00
Subtotal	$ **1438.00**
If "small entity," then enter half (1/2) of subtotal and subtract ☐ Applicant claims "small entity" status. ☐ Statement filed herewith	-$ 0.00
Rule 56 Information Disclosure Statement Filing Fee ($180.00)	$ 0.00
Assignment Recording Fee ($40.00)	$ 0.00
Other:	**0.00**
TOTAL FEE ENCLOSED	$ **1438.00**

The Commissioner is hereby authorized to charge any deficiency, or credit any overpayment, in the fee(s) filed, or asserted to be filed, or which should have been filed herewith (or with any paper hereafter filed in this application by this firm) to our Account No. 14-1140. A duplicate copy of this sheet is attached.

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NIXON & VANDERHYE P.C.
By Atty: Joseph A. Rhoa, Reg. No. 37,515

Signature: [signature]

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Patent Application of

KUBO et a. Atty. Ref.: 4034-27; Confirmation No.

Appl. No. 09/923,344 Group: 2814

Filed: 8/8/01 Examiner: Rao, Shrinivas

For: LIQUID CRYSTAL DISPLAY DEVICE

* * * * * * * * * * *

October 24, 2003

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

AMENDMENT

Responsive to the Official Action dated April 25, 2003 (for which petition is hereby made for a three month extension of time), please amend the above-identified application as follows:

AMENDMENTS TO THE CLAIMS:

This listing of claims will replace all prior versions, and listings, of claims in the application:

1. (Currently amended) A liquid crystal display device comprising:

a first substrate;

a second substrate;

a liquid crystal layer disposed between the first substrate and the second substrate; and

a plurality of picture element regions each defined by a first electrode provided on a face of the first substrate facing the liquid crystal layer and a second electrode provided on the second substrate so as to oppose the first electrode via the liquid crystal layer sandwiched therebetween,

wherein the first electrode includes a plurality of openings and a solid portion in each of the plurality of picture element regions,

the liquid crystal layer is in a substantially vertical orientation state in each of the plurality of picture element regions when no voltage is applied between the first electrode and the second electrode, and

when a voltage is applied between the first electrode and the second electrode, a plurality of liquid crystal domains ~~each in a radially-inclined orientation state~~ are formed in the plurality of openings and the solid portion by inclined electric fields generated at

respective edge portions of the plurality of openings of the first electrode, for producing a display by changing orientation states of the plurality of liquid crystal domains in accordance with the applied voltage, and

wherein each of said liquid crystal domains includes: (a) first liquid crystal molecules oriented substantially parallel to a normal of the first substrate thereby defining an axis, and (b) second liquid crystal molecules existing around all lateral sides of said axis and radially inclined relative to the axis.

2. (Original) The liquid crystal display device of Claim 1, wherein at least some of the plurality of openings have substantially the same shape and the same size, and form at least one unit lattice arranged so as to have rotational symmetry.

3. (Original) The liquid crystal display device of Claim 2, wherein each of the at least some of the plurality of openings is in rotationally symmetrical shape.

4. (Original) The liquid crystal display device of Claim 2, wherein each of the at least some of the plurality of openings is in a substantially circular shape.

5. (Original) The liquid crystal display device of Claim 2, wherein each region of the solid portion surrounded with the at least some of the plurality of openings is in a substantially circular shape.

6. (Original) The liquid crystal display device of Claim 2, wherein each region of the solid portion surrounded with the at least some of the plurality of openings is in a substantially rectangular shape with substantially arc-shaped corners.

7. (Original) The liquid crystal display device of Claim 1, wherein, in each of the plurality of picture element regions, a total area of the plurality of openings of the first electrode is smaller than an area of the solid portion of the first electrode.

8. (Original) The liquid crystal display device of Claim 1, further comprising a protrusion within each of the plurality of openings,

wherein a cross-sectional shape of the protrusion taken along a plane direction of the substrate is the same as a shape of the corresponding opening, and

a side face of the protrusion has an orientation-regulating force for orienting liquid crystal molecules of the liquid crystal layer in the same direction as an orientation-regulating direction obtained by the inclined electric field.

9. (Original) The liquid crystal display device of Claim 1, wherein the plurality of liquid crystal domains are in a spirally radially-inclined orientation state.

10. (Original) The liquid crystal display device of Claim 9, further comprising a pair of polarizing plates respectively provided outside of the first substrate and the second substrate and disposed with polarizing axes thereof crossing each other substantially perpendicularly,

wherein, in each of the plurality of liquid crystal domains, assuming that a liquid crystal molecule included in the liquid crystal layer and positioned in a 12 o'clock direction on a display surface in regard to a center of each of said plurality of liquid crystal domains is inclined against the 12 o'clock direction on the display surface by an angle θ, the polarization axis of one of the pair of polarizing plates is inclined in the same direction as inclination of the liquid crystal molecule positioned in the 12 o'clock direction on the display surface by an angle exceeding 0 degree and smaller than 2θ against the 12 o'clock direction on the display surface.

11. (Original) The liquid crystal display device of Claim 10, wherein the polarization axis of one of the pair of polarizing plates is inclined by an angle exceeding 0 degree and equal to θ or less.

12. (Original) The liquid crystal display device of Claim 10, wherein the polarization axis of one of the pair of polarizing plates is inclined by an angle substantially the same as $\theta/2$.

13. (Original) The liquid crystal display device of Claim 10, wherein the polarization axis of one of the pair of polarizing plates is inclined by an angle substantially the same as θ.

14. (Original) The liquid crystal display device of Claim 1,

wherein the solid portion includes a plurality of island portions arranged in the form of an m x n matrix and a plurality of branch portions for electrically connecting adjacent pairs of the plurality of island portions, and

the number of the plurality of branch portions is smaller than (2mn – m – n).

15. (Original) The liquid crystal display device of Claim 1,

wherein the first substrate further includes an active element provided correspondingly to each of the plurality of picture element regions, and

the first electrode corresponds to a picture element electrode provided in each of the plurality of picture element regions to be switched by the active element and the second electrode corresponds to at least one counter electrode opposing the plurality of picture element electrodes.

16-17. (Canceled)

18. (Currently amended) A liquid crystal display device comprising:

a first substrate;

a second substrate;

a liquid crystal layer disposed between the first substrate and the second substrate; and

a plurality of picture element regions each defined by a first electrode provided on a face of the first substrate facing the liquid crystal layer and a second electrode provided on the second substrate so as to oppose the first electrode via the liquid crystal layer sandwiched therebetween,

wherein, in each of the plurality of picture element regions, the liquid crystal layer is in a substantially vertical orientation state when no voltage is applied between the first electrode and the second electrode, and the first electrode includes a plurality of openings and a solid portion,

at least some of the plurality of openings have substantially the same shape and the same size, and form at least one unit lattice arranged so as to have rotational symmetry, and ~~The liquid crystal display device of Claim 16,~~ wherein each [[a]] region of the solid portion surrounded with at least some of the plurality of openings is in a substantially circular shape.

19. (Currently amended) A liquid crystal display device comprising:

a first substrate;

a second substrate;

a liquid crystal layer disposed between the first substrate and the second substrate; and

a plurality of picture element regions each defined by a first electrode provided on a face of the first substrate facing the liquid crystal layer and a second electrode provided on the second substrate so as to oppose the first electrode via the liquid crystal layer sandwiched therebetween,

wherein, in each of the plurality of picture element regions, the liquid crystal layer is in a substantially vertical orientation state when no voltage is applied between the first electrode and the second electrode, and the first electrode includes a plurality of openings and a solid portion,

at least some of the plurality of openings have substantially the same shape and the same size, and form at least one unit lattice arranged so as to have rotational symmetry, and

~~The liquid crystal display device of Claim 16,~~ wherein each [[a]] region of the solid portion surrounded with at least some of the plurality of openings is in a substantially rectangular shape with substantially arc-shaped corners.

20. (Currently amended) The liquid crystal display device of Claim [[16]]18, wherein the solid portion includes a plurality of island portions arranged in the form of an

m x n matrix and a plurality of branch portions for electrically connecting adjacent pairs of the plurality of island portions, and

the number of the plurality of branch portions is smaller than (2mn – m – n).

21. (New) The liquid crystal display device of Claim 1, wherein the liquid crystal layer includes a liquid crystal material having negative dielectric anisotropy.

22. (New) The liquid crystal display device of Claim 18, wherein the liquid crystal layer includes a liquid crystal material having negative dielectric anisotropy.

23. (New) The liquid crystal display device of Claim 19, wherein the liquid crystal layer includes a liquid crystal material having negative dielectric anisotropy.

24. (New) A liquid crystal display device comprising:

a first substrate;

a second substrate;

a liquid crystal layer disposed between the first substrate and the second substrate; and

a plurality of picture element regions each defined by a first electrode provided on a face of the first substrate facing the liquid crystal layer and a second electrode provided

on the second substrate so as to oppose the first electrode via the liquid crystal layer sandwiched therebetween,

wherein the first electrode includes a plurality of openings and a solid portion in each of the plurality of picture element regions,

the liquid crystal layer is in a substantially vertical orientation state in each of the plurality of picture element regions when no voltage is applied between the first electrode and the second electrode,

the solid portion of the first electrode includes a plurality of unit solid portions each substantially surrounded with at least some of the plurality of openings,

when a voltage is applied between the first electrode and the second electrode, a liquid crystal domain is formed in each of the plurality of openings and each of the plurality of unit solid portions by inclined electric fields generated at respective edge portions of the plurality of openings of the first electrode, and

wherein at least one of said liquid crystal domains includes: (a) first liquid crystal molecules oriented substantially parallel to a normal of the first substrate thereby defining an axis that is substantially normal to the first substrate, and (b) second liquid crystal molecules existing around all lateral sides of said axis and radially inclined relative to said axis.

25. (New) A liquid crystal display device comprising:

a first substrate;

a second substrate;

a liquid crystal layer disposed between the first substrate and the second substrate; and

a plurality of picture element regions each defined by a first electrode provided on a face of the first substrate facing the liquid crystal layer and a second electrode provided on the second substrate so as to oppose the first electrode via the liquid crystal layer sandwiched therebetween,

wherein the first electrode includes a solid portion formed from a conducting film and a nonsolid portion in which a conducting film is not formed in each of the plurality of picture element regions,

the liquid crystal layer is in a substantially vertical orientation state in each of the plurality of picture element regions when no voltage is applied between the first electrode and the second electrode,

the solid portion of the first electrode includes a plurality of unit solid portions each substantially surrounded with the nonsolid portion,

when a voltage is applied between the first electrode and the second electrode, a liquid crystal domain is formed in each of the plurality of unit solid portions by inclined electric fields generated at respective edge portions of the nonsolid portion of the first electrode, wherein the liquid crystal domain includes first liquid crystal molecules oriented substantially parallel to a normal of the first substrate thereby defining an axis

that is substantially normal to the first substrate, and second liquid crystal molecules existing around all lateral sides of said axis and radially inclined relative to said axis.

26. (New) The liquid crystal display device of Claim 1, wherein the liquid crystal display device is a transmission/reflection combination type liquid crystal display device.

27. (New) A liquid crystal display device comprising:

a first substrate;

a second substrate;

a liquid crystal layer disposed between at least the first substrate and the second substrate; and

a plurality of picture element regions, each including a first electrode supported by the first substrate facing the liquid crystal layer and a second electrode supported by the second substrate so as to oppose the first electrode,

wherein, in at least one of the picture element regions:

the first electrode includes a solid portion and a plurality of separate spaced apart openings defined in the solid portion, so that each of the openings is surrounded on all lateral sides by the solid portion,

wherein, in an absence of voltage between the first electrode and the second electrode in said picture element region, at least a substantial portion of the liquid crystal

layer in said picture element region includes liquid crystal molecules in a vertical orientation state,

when substantial voltage is applied between the first electrode and the second electrode in said picture element region, inclined electric fields are generated proximate respective edge portions of the plurality of openings defined in the solid portion of the first electrode in a manner so that said inclined electric fields cause a plurality of liquid crystal domains to be formed in the picture element region, so that a different liquid crystal domain is formed for each of the openings defined in the solid portion of the first electrode and at least one liquid crystal domain is formed over a solid portion of the first electrode between a pair of openings, and

wherein each liquid crystal domain for a corresponding opening defined in the solid portion of the first electrode includes liquid crystal molecules which are inclined and symmetrically oriented around all lateral sides of a vertical domain axis (SA) located in the corresponding opening, and wherein at least one liquid crystal molecule along the vertical domain axis (SA) at each openings is oriented in a vertical state when the substantial voltage is applied and wherein at least some liquid crystal molecules on opposite sides of the vertical domain axis (SA) for each opening are inclined in opposite directions.

28. (New) A liquid crystal display device comprising:

a first substrate;

a second substrate;

a liquid crystal layer disposed between at least the first substrate and the second substrate; and

a plurality of picture element regions, each including a first electrode supported by the first substrate facing the liquid crystal layer and a second electrode supported by the second substrate so as to oppose the first electrode,

wherein, in at least one of the picture element regions:

the first electrode includes a solid portion and a plurality of separate spaced apart openings defined in the solid portion, so that each of the openings is surrounded on all lateral sides by the solid portion,

wherein, in an absence of voltage between the first electrode and the second electrode in said picture element region, at least a substantial portion of the liquid crystal layer in said picture element region includes liquid crystal molecules in a vertical orientation state,

when substantial voltage is applied between the first electrode and the second electrode in said picture element region, inclined electric fields are generated proximate respective edge portions of the plurality of openings defined in the solid portion of the first electrode in a manner so that said inclined electric fields cause a plurality of liquid crystal domains to be formed in the picture element region, so that a different liquid crystal domain is formed for each of the openings defined in the solid portion of the first

electrode and at least one liquid crystal domain is formed over a solid portion of the first electrode between a pair of openings, and

wherein each liquid crystal domain for a corresponding opening defined in the solid portion of the first electrode includes liquid crystal molecules which are inclined and oriented around all lateral sides of a vertical domain axis (SA) located in the corresponding opening.

29. (New) The liquid crystal display device of claim 25, wherein an orientation of the liquid crystal domain and an orientation of the liquid crystal layer in the nonsolid portion are mutually continuous.

30. (New) The liquid crystal display device of claim 25, wherein the first electrode includes a plurality of openings defined therein, and wherein at least some of the plurality of openings have substantially the same shape and the same size, and form at least one unit lattice arranged so as to have rotational symmetry.

REMARKS

This is in response to the Office Action dated April 25, 2003. Claims 16-17 have been canceled. New claims 21-30 have been added. Thus, claims 1-15 and 18-30 are now pending.

Applicant notes with appreciation the courtesy extended by the Examiner during the interview held at the USPTO on October 9, 2003. The substance of the interview is set forth below.

Section 112 Rejection

Claims 2-3 stand rejected under 35 U.S.C. Section 112, second paragraph. In particular, the Office Action objects to the phrase "rotational symmetry" and contends that it is indefinite. This Section 112 rejection is respectfully traversed for at least the following reasons.

The phrase "rotational symmetry" is a well-known phrase used to describe shapes. Exhibits 1-3 attached hereto illustrate typical uses of the phrase "rotational symmetry", thereby evidencing the clear ordinary meaning of the phrase.

- Exhibit 1: Steven Dutch, Natural and Applied Sciences, University of Wisconsin – Green Bay. *Symmetry around a Point in the Plane*;
- Exhibit 2: *What is Rotational Symmetry*? URL: http://www.adrianbruce.com/Symmetry/120.htm.;

• Exhibit 3: Shoemaker, David, Carl Garland and Joseph Nibler, *Experiments in Physical Chemistry*. 5th Edition, McGraw-Hill, Inc. (pgs. 555-558).

As stated in Exhibit 1, the phrase "rotational symmetry" is used to describe objects having parts that "are related by rotation . . . . As a general rule, you can rotate such an object through a certain angle and it will still have the same appearance." For example, in figure b of Exhibit 1 the rotationally symmetrical shape "looks the same three times during a 360 degree rotation and is said to have three-fold [rotational] symmetry."

Stated yet another way, Exhibit 2 recites that "[a]n image has rotational symmetry if there is a centre point around which the object is turned a certain number of degrees and the object still looks the same, [i.e.,] it matches itself a number of times while it is being rotated."

Exhibits 1-3 clearly show that the phrase "rotational symmetry" is clear and definite as to its meaning. Such a well known and defined phrase cannot be indefinite. Thus, the Section 112 rejection should be withdrawn.

<u>Claim 1</u>

Claim 1 stands rejected under 35 U.S.C. Section 102(e) as being allegedly anticipated by Yoshida. This Section 102(e) rejection is respectfully traversed for at least the following reasons.

Claim 1 requires that "when a voltage is applied between the first electrode and the second electrode, a plurality of liquid crystal domains are formed in the plurality of

openings and the solid portion by inclined electric fields generated at respective edge portions of the plurality of openings of the first electrode, for producing a display by changing orientation states of the plurality of liquid crystal domains in accordance with the applied voltage, and wherein each of said liquid crystal domains includes: (a) first liquid crystal molecules oriented substantially parallel to a normal of the first substrate thereby defining an axis, and (b) second liquid crystal molecules existing around all lateral sides of said axis and radially inclined relative to the axis."

For example and without limitation, Fig. 2B of the instant application illustrates that when a voltage is applied between the first electrode 14 and the second electrode 22, a plurality of liquid crystal domains are formed in the plurality of openings 14a and the solid portion 14b by inclined electric fields (see equipotential lines EQ) generated at respective edge portions EG of the plurality of openings of the first electrode. As shown in Figs. 2B, 4C, 5, 15B, and 19 for example, and without limitation, each such domain formed by these inclined electric fields EQ at the edge portions EG of the openings includes: (a) first liquid crystal molecules oriented substantially parallel to a normal of the first substrate thereby defining an axis, and (b) second liquid crystal molecules existing around all lateral sides of said axis and radially inclined relative to the axis. For example, Fig. 2B illustrates first liquid crystal molecules oriented along axes SA so as to be parallel to a normal of the first substrate. The second molecules are radially inclined relative to the first molecules around all lateral sides thereof as shown in Figs. 2B, 4C, 5,

15B, and 19 for example. This allows viewing angle dependence of display quality to be reduced, thereby resulting in improved display characteristics.

The cited art fails to disclose or suggest the aforesaid underlined and quoted aspect of claim 1.

Yoshida, in particular, fails to disclose or suggest any sort of liquid crystal domain including "(a) first liquid crystal molecules oriented substantially parallel to a normal of the first substrate thereby defining an axis, and (b) second liquid crystal molecules existing around all lateral sides of said axis and radially inclined relative to the axis" as recited in claim 1. The difference between Yoshida and an example embodiment of this invention is shown in Exhibit 4 attached hereto.

In particular, the left-hand drawing of Exhibit 4 shows that stripe-shaped electrode 20 in Yoshida, in combination with parallel stripe-shaped common electrodes 18, causes the liquid crystal molecules on either side of stripe-shaped electrode 20 to be oriented in the *same* direction slanting away from the electrode 20. In this regard, Exhibit 4 is a top view of the effect caused by Fig. 4 of Yoshida. In contrast, the right-hand drawing of Exhibit 4 is Fig. 4C of the instant application – an example of domains according to this invention. It can be seen from the right-hand side of Exhibit 4 that the liquid crystal molecules in each domain are radially inclined relative to the domain's central axis *around all lateral sides* of the axis. The difference between Yoshida and certain embodiments of this invention is clear.

In particular, Yoshida clearly fails to disclose or suggest any sort of liquid crystal domain which includes "(a) first liquid crystal molecules oriented substantially parallel to a normal of the first substrate thereby defining an axis, and (b) second liquid crystal molecules existing around ***all lateral sides*** of said axis and radially inclined relative to the axis" as recited in claim 1. Yoshida is entirely unrelated to the invention of claim 1 in this regard. Claim 1 cannot possibly be anticipated or otherwise unpatentable in view of Yoshida.

Claim 4

Claim 4 requires that "each of the at least some of the plurality of openings is in a substantially circular shape." For example, Fig. 9 of the instant application illustrates circular openings 14a in the first electrode 14.

Yoshida fails to disclose or suggest this aspect of claim 4. Moreover, one of ordinary skill in the art would recognize that Yoshida's electrodes 18, 20 must be parallel for the display to function properly; thus, one of ordinary skill in the art would never have modified Yoshida to provide for substantially circular openings as called for in claim 4.

Furthermore, Uemura also fails to disclose or suggest substantially circular openings in a first electrode as called for in claim 4. Uemura in Fig. 1 merely discloses polymer walls, not openings in electrode(s). Thus, even the alleged combination of Yoshida and Uemura would fail to meet the invention of claim 4.

Claim 5

Claim 5 requires that "each region of the solid portion surrounded with the at least some of the plurality of openings is in a substantially circular shape." For example, Fig. 1A of the instant application illustrates solid portions 14b that are substantially circular in shape. Again, the cited art fails to disclose or suggest this aspect of claim 5, either alone or in combination.

Yoshida requires parallel electrodes, and thus cannot possibly disclose or suggest electrode solid portions that are substantially circular in shape as called for in claim 5. Figs. 28-30 of Yoshida are not top views, but are side cross sectional views. The parallel stripe-shaped electrodes 72, 76 of Yoshida have no substantially circular shaped portions as viewed from above.

Moreover, Uemura in Fig. 6 also fails to disclose or suggest this aspect of claim 5. Fig. 6 is a graph, not a view of an electrode.

Since both Yoshida and Uemura fail to disclose or suggest the claimed invention of claim 5, it can be seen that even if the references were combined (which applicant believes would be incorrect in any event), the invention of claim 5 still would not be met.

Claim 6

Claim 6 requires that "each region of the solid portion surrounded with the at least some of the plurality of openings is in a substantially rectangular shape with substantially arc-shaped corners." E.g., see Fig. 7B and 8B of the instant application.

Again, both Yoshida and Uemura fail to disclose or suggest this aspect of claim 6. Thus, even if the references were combined (which applicant believes would be incorrect in any event), the invention of claim 6 still would not be met.

Claim 7

Claim 7 requires that "in each of the plurality of picture element regions, a total area of the plurality of openings of the first electrode is smaller than an area of the solid portion of the first electrode." The cited art fails to disclose or suggest this aspect of claim 7, either alone or in combination.

Claim 8

Claim 8 calls for "a protrusion within each of the plurality of openings, wherein a cross-sectional shape of the protrusion taken along a plane direction of the substrate is the same as a shape of the corresponding opening, and a side face of the protrusion has an orientation-regulating force for orienting liquid crystal molecules of the liquid crystal layer in the same direction as an orientation-regulating direction obtained by the inclined electric field."

The cited art discloses nothing akin to this aspect of claim 8. Uemura's polymer wall cited by the Office Action is not formed in any opening, and thus cannot possibly have a shape that is substantially the same as the opening as called for by claim 8. Again, the art is entirely unrelated to the invention of claim 8.

Claim 9

Claim 9 requires that a "plurality of liquid crystal domains are in a ***spirally*** radially-inclined orientation state." Again, the cited art fails to disclose or suggest this aspect of claim 9, either alone or in combination. Uemura uses a horizontally aligned type LC material, where claim 9 (via claim 1) uses an LC material that is of the substantially vertically aligned type for forming a spirally radially-inclined orientation state. The two are entirely unrelated to one another.

Claim 18

Claim 18 requires that "the first electrode includes a plurality of openings and a solid portion, at least some of the plurality of openings have substantially the same shape and the same size, and form at least one unit lattice arranged so as to have rotational symmetry, and wherein each region of the solid portion surrounded with at least some of the plurality of openings is in a substantially circular shape." For example, Fig. 1A of the instant application illustrates solid portions 14b that are substantially circular in shape. Again, the cited art fails to disclose or suggest this aspect of claim 18, either alone or in combination.

Yoshida requires parallel *stripe-shaped* electrodes, and thus cannot possibly disclose or suggest electrode solid portions substantially circular in shape as called for in claim 18. Figs. 28-30 of Yoshida are not top views, but are side cross sectional views. The parallel stripe-shaped electrodes 72, 76 of Yoshida have no substantially circular shaped solid portions.

Moreover, Uemura in Fig. 6 also fails to disclose or suggest this aspect of claim 18. Fig. 6 is a graph, not a view of an electrode.

Since both Yoshida and Uemura fail to disclose or suggest the claimed invention of claim 18, it can be seen that even if the references were combined (which applicant believes would be incorrect in any event), the invention of claim 18 still would not be met.

Claim 19

Claim 19 requires that for the first electrode, "each region of the solid portion surrounded with at least some of the plurality of openings is in a substantially rectangular shape with substantially arc-shaped corners." E.g., see Fig. 7B and 8B of the instant application.

Again, both Yoshida and Uemura fail to disclose or suggest this aspect of claim 19. Thus, even if the references were combined (which applicant believes would be incorrect in any event), the invention of claim 19 still would not be met.

Claim 20

Claim 20 requires that the "solid portion includes a plurality of island portions arranged in the form of an m x n matrix and a plurality of branch portions for electrically connecting adjacent pairs of the plurality of island portions, and the number of the plurality of branch portions is smaller than (2mn – m – n)." Again, the cited art fails to disclose or suggest this aspect of claim 20.

<u>Claim 24</u>

Claim 24 requires that "when a voltage is applied between the first electrode and the second electrode, a liquid crystal domain is formed in each of the plurality of openings and each of the plurality of unit solid portions by inclined electric fields generated at respective edge portions of the plurality of openings of the first electrode, and wherein at least one of said liquid crystal domains includes: (a) first liquid crystal molecules oriented substantially parallel to a normal of the first substrate thereby defining an axis that is substantially normal to the first substrate, and (b) second liquid crystal molecules existing *around all lateral sides of said axis and radially inclined relative to said axis*." Again, the cited art fails to disclose or suggest this aspect of claim 24.

<u>Claim 25</u>

Claim 25 requires that "when a voltage is applied between the first electrode and the second electrode, a liquid crystal domain is formed in each of the plurality of unit solid portions by inclined electric fields generated at respective edge portions of the nonsolid portion of the first electrode, wherein the liquid crystal domain includes first liquid crystal molecules oriented substantially parallel to a normal of the first substrate thereby defining an axis that is substantially normal to the first substrate, and *second liquid crystal molecules existing around <u>all lateral sides</u> of said axis and radially inclined relative to said axis*." Again, the cited art fails to disclose or suggest this aspect of claim 25.

Claim 27

Claim 27 requires that for a domain "liquid crystal molecules which are inclined and symmetrically oriented around all lateral sides of a vertical domain axis (SA) located in the corresponding opening, and wherein at least one liquid crystal molecule along the vertical domain axis (SA) at each openings is oriented in a vertical state when the substantial voltage is applied and wherein at least some liquid crystal molecules on opposite sides of the vertical domain axis (SA) for each opening are inclined in opposite directions." Again, the cited art fails to disclose or suggest this aspect of claim 27.

Miscellaneous

Following the interview, the Examiner called the undersigned and requested a brief explanation as to U.S. Patent Nos. 6,342,938 and 6,078,376. Responsive thereto, it is noted that the '938 Patent relates to an MVA-type LCD which discloses LC molecules only being aligned in two or four directions. Thus, in contrast to claim 1 of the instant application, the '938 Patent fails to disclose or suggest both the (a) and (b) types of molecule orientations recited in that claim. Meanwhile, the '376 Patent fails to disclose or suggest forming a plurality of domains per a first electrode (in contrast with claim 1 of the instant application) – the '376 Patent is entirely unrelated to the invention of claim 1 in this regard.

Conclusion

For at least the foregoing reasons, it is respectfully requested that all rejections be withdrawn. All claims are in condition for allowance. If any minor matter remains to be resolved, the Examiner is invited to telephone the undersigned with regard to the same.

Respectfully submitted,

NIXON & VANDERHYE P.C.

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